(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
6 December 2001 (06.12.2001)

PCT

(10) International Publication Number
WO 01/93455 A1

(51) International Patent Classification[7]: H04B 7/005

(21) International Application Number: PCT/EP01/06148

(22) International Filing Date: 30 May 2001 (30.05.2001)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
0013056.7 31 May 2000 (31.05.2000) GB

(71) Applicant (*for all designated States except US*): MOTOROLA INC [US/US]; 1303 E. Algonquin Road, Schaumburg, IL 60196 (US).

(72) Inventors; and
(75) Inventors/Applicants (*for US only*): O'NEIL, Rorie [GB/GB]; 25 Applewood Court, Swindon, Wiltshire SN5 7AH (GB). ANDERSON, Nicholas, William [GB/GB]; 26 Church Hill, Wroughton, Swindon, Wiltshire SN4 9JS (GB).

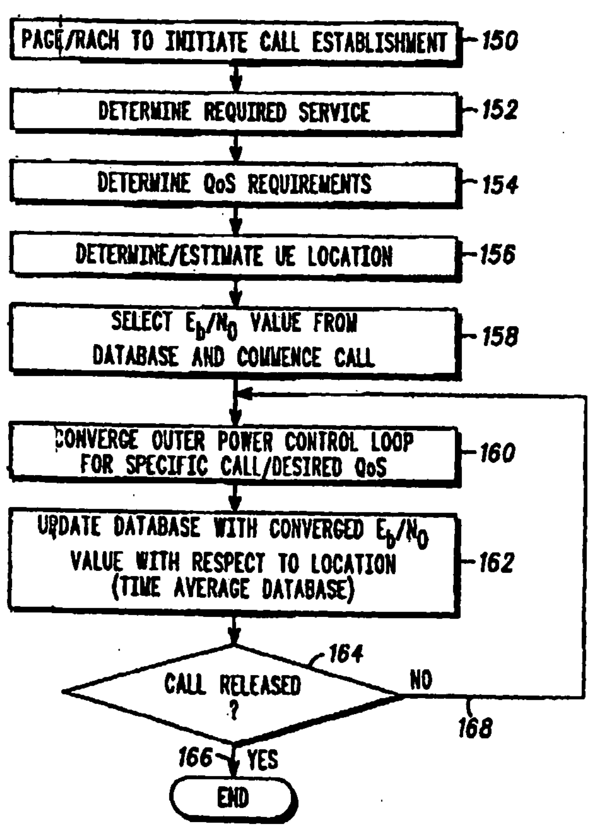
(74) Agent: JEPSEN, Rene; Motorola European Intellectual, Property Operations, Midpoint, Alencon Link, Basingstoke, Hampshire RG21 7PL (GB).

(81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian

[Continued on next page]

(54) Title: COMMUNICATION SYSTEM, CALL ESTABLISHMENT PROCEDURE AND METHOD OF POWER CONTROL IN A RADIO COMMUNICATIONS ENVIRONMENT



(57) Abstract: Upon call set-up requests in a CDMA-based communication system (1), an outer power control loop function is initially armed (158) with a time-averaged E_b/N_o value for a desired quality of service (QoS) of a specific service-type, e.g. voice, data or video, at a particular location. Clearly, different locations (X_n, Y_n) within the communication system (10) are subject to different propagation environments and so the time-averaged E_b/N_o values (110) vary between services and locations. Generally, as exemplified in Fig 3, an RNC (36-40) is operable to maintain a continuously updated database (100) through recodal of converged outer loop targets (for a cell or georgraphic location) for each specific type of service. When a new call is initiated (150), an initial outer power control loop target is taken (110) to be the time-averaged E_b/N_o valude from the database (100). In this way, any transient period (160) between call establishment (150-158) and convergence to a true required outer loop threshold is reduced, increasing overall network quality and capacity. The initial default within the database (100) doe not need to be chosed with particular care since it will soon be updated once an associated Node B (26-31) goes live, tereby avoiding the necessity of having to extensively system test new Node B sites in an interference-critical radio environment. The process of updating location-specific converged E_b/N_o values may be maintained (168) in-call.

WO 01/93455 A1

patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report*
— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*
— *entirely in electronic form (except for this front page) and available upon request from the International Bureau*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

POWER CONTROL METHOD DURING CALL ESTABLISHMENT IN A RADIO COMMUNICATIONS SYSTEM

Background to the Invention

This invention relates, in general, to communication systems, and is particularly, but not exclusively, applicable to a wideband or "spread spectrum" cellular communication system such as those employing code division multiple access (CDMA) and having a power control mechanism employed within a CDMA call set-up procedure to define a desired quality of service (QoS).

Summary of the Prior Art

In a cellular communication system, a plurality of base stations provide radio telecommunication services to a plurality of subscriber units (interchangeably referred to as User Equipment, UE), principally mobile units moving at different velocities and in different radio propagation environments. Each base station defines a particular geographical area or cell proximate to the base station, with these cells combining to produce an extensive coverage area. The communications link from the base station to a mobile subscriber unit is referred to as the downlink. Conversely, the communications link from a mobile subscriber unit to the base station is referred to as the uplink.

Multiple access techniques permit simultaneous transmissions from several mobile subscriber units to a single base station over a plurality of communications channels. Some channels are used for carrying traffic while other channels (which may be logical or dedicated channels) are used for transferring control information, such as call paging, between the base station and the subscriber units. Some examples of multiple access techniques are frequency division multiple access (FDMA), time division multiplexing/multiple access (TDM, TDMA) and code division multiple access (CDMA). A CDMA-type system employs spread spectrum signaling.

One of the communication protocols proposed for use in the Universal Mobile Telephone System (UMTS) is wideband code-division multiple access (W-CDMA). In contrast to TDM-based cellular systems, a CDMA-based system has a universal frequency re-use that allows frequencies to be used across the entire network, i.e. there is a frequency re-use of one. Such CDMA-based systems operate by virtue of the fact that a single carrier frequency supports a number of communication resources that are structured from discrete, coded sequences. More specifically, each channel is comprised from a unique coded sequence of "chips" that are selected from a relatively long pseudo-random spreading sequence (typically many millions of bits in length). A communication device has access to an information-bearing channel by virtue of a communication device having particular and detailed knowledge of a specific code that identifies the specific bits used by the information-bearing channel. Individual users to the system therefore use a common radio frequency (RF) but are separated by the individual spreading codes. In the down-link each base station is assigned a single spreading code and each of the physical channels is then assigned a separate channelisation code; in UMTS the orthogonal variable spreading factor (OVSF) code set is used. In the up-link, each mobile is assigned its own unique long spreading code.

Information (such as voice, data or video) is spread across many chips of the spreading sequence on a unique basis, with a processing gain of the system determined by the number of chips required to construct a single data bit. In this way, less than one bit of information is transmitted per chip. Essentially, the processing gain is a ratio defined by the number of chips required per symbol/bit (generally fixed for the network) against a rate at which the underlying information is transmitted. In general, it is therefore better that a receiver is subject to high processing gain in order that it is better able to distinguish each user signal against a background of other-user generated interference and system noise.

CDMA-based systems therefore inherently operate in an interference environment because many channels utilise the same carrier frequency, with individual channels merely differing from one another in terms of their uniquely defined coded sequences. However, CDMA-based systems become statistically efficient for large populations of users, and therefore present an attractive and more efficient alternative to FDM-based systems.

With UMTS, the chip-rate is presently fixed at 3.84M chips per second, with the number of chips representing one information bit variable according to the rate and type/quality of service. As such, a decrease in the number of chips per information bit increases the rate of the service, but this decrease effectively requires increased levels of forward error correction or the like.

Two categories of spread spectrum communications are: i) direct sequence spread spectrum (DSSS); and ii) frequency hopping spread spectrum (FHSS). In an operational sense, as described, the spectrum of a signal is spread in DSSS (defined in TIA-EAI standard IS-95) by multiplying it with a wide-band pseudo-random code generated signal.

One feature of the current GSM system, which is envisaged for UMTS, allows the transceivers in the base station and subscriber unit to adjust their power output to take into account the distance between them. The closer the subscriber unit is to the base station's transceiver, the less power it and the base station's transceiver will be required to transmit. This feature saves battery power in the subscriber unit and also helps to reduce interference effects. Both up-link and down-link power settings can be controlled independently. Initial power settings for the subscriber unit, along with other control information, are set by the information provided on a broadcast control channel (BCCH) for a particular cell. The base station controls the transmit power of both the subscriber unit and the base station's transceiver. The base station monitors the power in up-link

transmissions received from the subscriber unit, and the power received in down-link transmissions from the base station is monitored by the subscriber unit and, generally, then reported to the base station. Using these measurements, the power of both the subscriber unit and the base station's transceiver can be adjusted accordingly to reflect optimum system performance and desired quality of service (QoS). The broadcast control channel is transmitted by the base station's transceiver at all times and at constant power. In addition to a power control indicator, the BCCH also carries other information such as cell identity, a list of frequencies used in the cell, and a list of neighbouring cells to be monitored by the subscriber unit.

Accurate reverse link power control is a critical element of CDMA systems as the spreading codes are not orthogonal on the reverse link and any errors in power control produces interference that directly reduces system capacity.

By way of intermediate summary, although CDMA-based systems can benefit from the use of multiple carriers within specific cells and generally within the system as a whole, CDMA effectively provides a homogenous carrier frequency environment for an area served by a multiplicity of cells. As a consequence, the interference between neighbouring cells is tightly related. This can be contrasted with frequency based systems, such as the global system for mobile communication (GSM), where carrier frequency re-use in adjacent or near-adjacent cells is restricted to avoid co-channel and adjacent channel interference. GSM, in fact, utilises a mix of frequency division duplex (FDD) and time division multiplexing (TDM) protocols to provide dedicated, duplex-spaced up-link and down-link channels on allocated time-slot resources of a frame. For UMTS and CDMA2000, an FDD-CDMA protocol has been adopted as an air interface standard.

In a CDMA-based system, it is necessary to restrict a composite power of all interfering signals since the processing gain is generally a constant value for a

user transmitting at a constant information rate. The restriction of power is such that the processing gain for each user is sufficient for each desired signal to be extracted from all other interfering signals with adequate signal integrity. CDMA-based systems (and the like) utilise power control functions to control the power transmitted by each user (whether this is controlled by the user or administered by the network) such that a serving cell-site should ideally receive an incident signal at an appropriate power level relative to all other interfering signals. Generally, the serving cell will be the cell in which the user's subscriber unit (whether this is a mobile or a portable terminal) is located. Consequently, power control generally renders subscriber unit transmission at a relatively low power level. In fact, for a given capacity, the lower the allowed minimum user equipment (UE) transmit power the lower the noise rise (meaning greater system capacity, range and increased UE battery life).

The relationship between noise rise with cell loading as a function of the minimum transmit power level (allowed for mobiles in the system) is described in the paper "FDD UE minimum transmission power simulation results" – TSGW4#6(99) 395 presented in TSG-RAN Working Group 4 #6, South Queensferry, Scotland (26-29'th July 1999).

As will be understood, the actual transmit power of the mobile has a fixed dynamic range dictated by practical size and cost constraints. Consequently, the transmit power of, for example, a mobile is constrained to lie somewhere within this fixed dynamic range. If the mobile is situated close to a base station with which it is communicating, then the path loss between the mobile and the base should, in general, be low meaning that the transmission power of the mobile to achieve a given Signal to Interference Ratio (SIR) can also be low.

In some instances, so-called soft-handover algorithms are employed. Soft-handover relates to uplink communications from a subscriber unit within a specific cell, wherein such uplink communications are decoded by multiple base

station sub-systems (BSSs) in adjacent (i.e. non-primary) cells. Soft-handover is therefore designed to obviate some need for increasing up-link transmission power since it provides space diversity and consequently a better quality of service (QoS) for a nominally selected transmitted power level. Consequently, in systems that constantly seek to limit an interference environment, soft-handover can provide an improved QoS (e.g. reduced frame erasure rates (FERs) or reduced bit error rates (BERs)) for the same power. CDMA systems are therefore geared to look to soft-handover, if possible.

On a larger scale, as the user moves around the network so the cell in which the user is located generally changes in order to maintain as low a transmit power as possible, thus attempting to limit overall system interference. Unfortunately, a radio propagation environment constantly varies with time, with a channel between a subscriber unit and a cell site potentially subject to large variations in path loss. Power control functions operate to mitigate such undesirable signal attenuation (i.e. variations in path loss), with the level of attenuation therefore directly adversely affecting quality of service (QoS) to and from a subscriber unit. Moreover, increasing path loss inevitably tends to lead to a corresponding change in subscriber unit transmit power designed to offset the path loss (such increase in power consequently affects overall system interference).

QoS for a given connection is usually defined in terms of target bit error rate (BER), block error rate (BLER) or frame erasure rate (FER). A mobile unit's speed and specific propagation environment will both have a major impact on the required signal to interference ratio (SIR) needed at the base station to maintain the desired quality of service target.

The FDD interface, as inferred above, is based on W-CDMA. As such, it is sensitive to power control mismatches in the uplink because of fast fading in the communication's channel. Fast fading is caused by the signal arriving at a receiver via a number of different paths). Therefore, in order to achieve

maximum up-link capacity in a CDMA system, fast power control loops are required.

Unfortunately, during call set-up, neither a Node B (i.e. a CDMA base station) nor a subscriber unit has any idea of its radio environment, which environment supports scattering and multipath effects and which environment is nevertheless affected by mobile speed.

A significant issue arises in this respect of call establishment in a CDMA environment.

An outer power control loop essentially looks to a desired quality of service (QoS) metric for a connection and then maps the desired QoS to what appears to be a corresponding ratio of energy required per information bit to the noise power spectral density level, E_b/N_0, for a connection. In other words, the purpose of the outer loop is to set the required E_b/N_0 target to achieve a given QoS, usually defined in terms of bit error rate (BER) or frame erasure rate (FER) targets that must be maintained. As will be understood, E_b/N_0 essentially corresponds to a signal to noise (S/N) ratio, with N_0 representing a combined noise and interference measure.

Examples of factors which will impact the required E_b/N_0 to achieve a given QoS are the multipath power delay profile and the relative speed of motion of the mobile observed at the Node B. For example, for a basic 8kbps speech service, a change in speed from three kilometres per hour (3km/h) to 120 km/h degrades performance by around two decibels (2dB).

Having set the necessary outer loop target, it is the job of an inner loop to maintain the received E_b/N_0 as close as possible to the outer loop target. The loop bandwidth of the outer loop is typically significantly smaller than that of the inner loop since (broadly speaking) its job is to respond to gross changes in the

propagation environments which will lead to changes in the operating point of a given connection (to reach the same quality of service). The inner power control loop therefore adjusts a subscriber unit's transmission power to counter the so-called near-far problem and to track the E_b/N_0 requirement. This simply means adjusting the transmission power of each connection such that the received signal power observed at the base station (or Node B in UMTS context) is *just* sufficient to meet the QoS (Quality of Service) requirement of each particular connection; thereby reducing interference to others in the system.

The inner power control loop controlled by the Node B therefore operates to instruct a subscriber unit to increase/decrease its transmission power in finite steps. Generally, an assessment by the subscriber unit that the received/perceived QoS is "x" and a reply to the Node B that the desired QoS is "y" results in the inner power control loop altering the E_b/N_o to move towards/attain QoS "y". Unfortunately, there is some convergence time before attainment of an appropriate E_b/N_o condition (associated with a desired QoS), with this convergence time being typically between about 0.5 and one second (which is significant in radio management terms).

Unfortunately, the transmission power required to meet the BER/FER targets is entirely unknown at call establishment since the radio propagation path varies with time.

Applying this problem to the development of CDMA-based communication in third generation systems, namely UMTS, it is noteworthy that internet traffic is being increasingly supported across radio interfaces. Unfortunately, Internet traffic (especially downstream communication) requires high data rates whilst short bursty transmissions exacerbate the underlying problem of E_b/N_o convergence. Consequently, not only do the inner and outer power control loops have potentially insufficient time to assess the radio environment and hence to converge, but such convergence presently imposes significant overhead to the

system in general in terms of transmit power. Furthermore, with high data rate services, a cell's diameter effectively shrinks because the power/energy per bit is constant for the system (as defined by the E_b/N_o requirement), whereas the output power from a subscriber unit is also constrained.

From a practical perspective, if the E_b/N_o value is set too high by the outer power control loop, then network capacity suffers because transmissions will degrade the interference environment (as a result of increased power transmissions and/or a potential backing off in data transmissions rate). In other words, high data rate users potentially cause significant interference through over-power transmissions on a single wideband carrier. For example, to a first approximation, a device transmitting data at 384kbps appears as forty-eight equivalent voice users and introduces the combined interference of forty-eight voice users (as a consequence of increased data rate being associated with increased transmit powers). Conversely, if the E_b/N_o value is set too low, then a subscriber unit will incur a reduced quality of service.

By way of specific operational summary, when a CDMA connection is first established an outer loop threshold is required in both the user equipment (UE) and the Node B. This threshold is set by the outer power control loop which is a function of a layer 3 radio network controller (RNC) for the Node B. For existing second generation CDMA-based air interfaces, initial the E_b/N_0 targets are set at the same level (for a given service) in all BTS's; this apparently being representative of a reasonable starting point conditioned on observations of performance across a broad range of propagation conditions. However, all BTS's are not placed in similar environments. The outer power control loop then acts to converge to the actual required target (for each specific connection/service).

At present, the responsibility of setting and controlling the outer and inner power control loops may reside with either or both of the infrastructure and the

subscriber unit. However, the inventors have recognised that it is clearly preferable that the E_b/N_0 parameter is determined by the base station sub-system since it is better placed to make a valued assessment of an overall interference environment. In contrast, a quality of service measurement at a subscriber unit may suggest the requirement for unnecessary high power transmissions (to satisfy a calculated E_b/N_0) from the subscriber unit which result in near-far problems.

CDMA-based systems must therefore necessarily impose and retain strict power controls on all transmissions, with this being particularly important in relation to transmissions from mobile communication devices. Unfortunately, CDMA systems are prone to operational instability, in the face of mobiles in close proximity to base station transceivers, and when such mobiles transmit at unnecessarily high power levels that directly interfere with reception at proximate cell sites. More particularly, as will now be appreciated, high-powered transmissions from the mobile will swamp the universal frequency carrier and therefore corrupt information-bearing communications. In the extreme, unwarranted high power transmissions can ripple-through the CDMA environment and can potentially unbalance the whole CDMA system to an extent where system-wide failure can result; this is clearly catastrophic for a network operator and must be avoided at all costs.

Summary of the Invention

According to a first aspect of the invention there is provided a communication system supporting a call between a base station and user equipment, the communication system comprising:

means for updating at least one initial outer power control loop threshold, for use by the base station and at least one user equipment when initiating a communication, wherein the updating of the initial threshold is performed dependent upon at least one communication service type.

Preferably the communication system is a CDMA-based system and the threshold is an E_b/N_0 value, the CDMA-based communication system comprising: means for converging an estimated E_b/N_0 value to a call-specific E_b/N_0 value representative of a desired quality of service between the base station and the user equipment. In the preferred embodiment a database stores a multiplicity of time-averaged E_b/N_0 values obtained in relation to a plurality of geographic locations within the CDMA-based communication system and in relation to at least one service; and means for selecting one of the multiplicity of time-averaged E_b/N_0 values, at call initiation between the base station and the user equipment, for use as the estimated E_b/N_0 value within the outer power control loop, said one of the multiplicity of time-averaged E_b/N_0 values selected from the database dependent upon at least an assessed geographic location of the user equipment.

Preferably, said selected one of the multiplicity of time-averaged E_b/N_0 values is selected by the means for selecting further based on a desired service for the call.

Converged call-specific E_b/N_0 values are preferably communicated to the database for updating the database on at least a periodic basis.

In one embodiment, the database is associated with one of the base station and a radio network controller.

In another aspect of the present invention there is provided a method of setting-up a call between a base station and user equipment for setting up a call between a base station and user equipment of a communication system, the method comprising the step of updating at least one initial outer power control loop threshold, for use by the base station and at least one user equipment when initiating communication, wherein the updating of the initial threshold is performed dependent upon at least one communication service type.

Preferably the communication system is a CDMA-based communication system, the call subject to power control from an outer power control loop that converges an estimated E_b/N_0 value to a call-specific E_b/N_0 value representative of a desired quality of service between the base station and the user equipment;storing, in a database, a multiplicity of time-averaged E_b/N_0 values obtained in relation to a plurality of geographic locations within the CDMA-based communication system and in relation to at least one service; and selecting one of the multiplicity of time-averaged E_b/N_0 values, at call initiation between the base station and the user equipment, for use as the estimated E_b/N_0 value within the outer power control loop, said one of the multiplicity of time-averaged E_b/N_0 values selected from the database dependent upon at least an assessed geographic location of the user equipment.

In a further aspect of the present invention there is provided base site equipment for a communication system wherein the communication system is a CDMA communication system, the base site equipment further comprising means for controlling an outer power control loop for converging an estimated E_b/N_0 value to a call-specific E_b/N_0 value representative of a desired quality of service between the transceiver and the user equipment.

Preferably the communication system is a CDMA-based communication system supporting a call between a transceiver and user equipment, the base site equipment comprising: means for controlling an outer power control loop for converging an estimated E_b/N_0 value to a call-specific E_b/N_0 value representative of a desired quality of service between the transceiver and the user equipment; the base site equipment coupled, in use, to a database storing a multiplicity of time-averaged E_b/N_0 values obtained in relation to a plurality of geographic locations within the CDMA-based communication system and in relation to at least one service; and wherein the base site equipment further includes: means for selecting one of the multiplicity of time-averaged E_b/N_0 values, at call

initiation between the transceiver and the user equipment, for use as the estimated E_b/N_0 value within the outer power control loop, said one of the multiplicity of time-averaged E_b/N_0 values selected from the database dependent upon at least an assessed geographic location of the user equipment.

In yet another aspect of the present invention there is provided a method of controlling, within base site equipment, set-up of a wideband call between a transceiver and user equipment of a CDMA-based communication system, the method comprising the step of updating at least one initial outer power control loop threshold, for use by the base station and at least one user equipment when initiating a communication, wherein the updating of the initial threshold is performed dependent upon at least one communication service type.

Preferably the CDMA call is subject to power control from an outer power control loop that converges an estimated E_b/N_0 value to a call-specific E_b/N_0 value representative of a desired quality of service between the transceiver and the user equipment; storing, in a database, a multiplicity of time-averaged E_b/N_0 values obtained in relation to a plurality of geographic locations within the CDMA-based communication system and in relation to at least one service; and selecting one of the multiplicity of time-averaged E_b/N_0 values, at wideband call initiation between the transceiver and the user equipment, for use as the estimated E_b/N_0 value within the outer power control loop, said one of the multiplicity of time-averaged E_b/N_0 values selected from the database dependent upon at least an assessed geographic location of the user equipment.

In a further aspect of the present invention there is provided a subscriber unit for a communication system, the subscriber unit arranged, in use, to support a wideband call to a transceiver, the subscriber unit comprising: means for updating at least one initial outer power control loop threshold, for use by the base station and at least one user equipment when initiating a communication,

wherein the updating of the initial threshold is performed dependent upon at least one communication service type.

Preferably the subscriber unit further comprises means for administering an outer power control loop that converges an estimated E_b/N_0 value to a call-specific E_b/N_0 value representative of a desired quality of service between the transceiver and the subscriber unit; a database storing a multiplicity of time-averaged E_b/N_0 values obtained in relation to a plurality of geographic locations within the CDMA-based communication system and in relation to at least one service; and means for selecting one of the multiplicity of time-averaged E_b/N_0 values, at wideband call initiation, for use as the estimated E_b/N_0 value within the outer power control loop, said one of the multiplicity of time-averaged E_b/N_0 values selected from the database dependent upon at least an assessed geographic location of the user equipment.

Said selected one of the multiplicity of time-averaged E_b/N_0 values may be selected by the means for selecting further based on a desired service for the call.

In still yet a further aspect of the present invention there is provided a communication system supporting a call between a base station and user equipment, the communication system comprising: means for controlling an operational parameter adversely influenced by a change in propagation environment;a database storing a multiplicity of time-averaged operational parameters obtained in relation to a plurality of geographic locations within the communication system; means for selecting one of the multiplicity of time-averaged operational parameters for use as an initial estimate of the operational parameter adversely influenced by a change in propagation environment, said one of the multiplicity of operational parameters selected from the database dependent upon at least an assessed geographic location of the user

equipment; and means for converging the initial estimate of the operational parameter to a call-specific operational parameter optimised for the call.

In other words, the outer loop power control function and RNC are operable to maintain a continuously updated database that records converged outer loop targets (for a cell or geographic location) for a specific type of service. When a new call is initiated, the initial loop target is taken as the average from the database. In this way, any transient period between call establishment and convergence to the true required outer loop threshold is reduced, increasing overall network quality and capacity. The initial default does not need to be chosen with particular care since it will soon be updated once the Node B goes live.

Advantageously, the present invention enhances capacity and improves quality of a CDMA environment, such as W-CDMA employed within UMTS.

Brief Description of the Drawings

Embodiments of the invention are described below, by way of example only, with reference to the following drawings, in which:

FIG. 1 shows a block diagram of a cellular communications system which can be adapted to support the various inventive concepts of the preferred embodiments of the present invention;

FIG. 2 is a representation of a database according to a preferred embodiment of the present invention, the database utilised within the cellular communication system of FIG. 1; and

FIG. 3 is a flow diagram of a preferred operating methodology of the present invention.

Detailed Description of a Preferred Embodiment

FIG. 1 shows, in outline, a cellular communications system 10 supporting at least a CDMA-based communication protocol. The cellular communication

system may, in fact, support multiple air-interfaces (of which one offers a universal frequency re-use across a plurality of adjacent cells). For example, the communication system 10 may support a GSM communications protocol and a W-CDMA communications protocol. Generally, the air-interface protocols are administered from (ostensibly) co-located base sites individually assigned to specific cells 11-16.

A plurality of subscriber units 17-20, such as a mixture of mobile units (MSs) and fixed terminals, communicate over a selected air-interface 21-25 with a plurality of Node Bs 26-31 (i.e. base transceiver stations in CDMA parlance). The Node Bs 26-31 may be connected to a conventional public-switched telephone network (PSTN) 34 through radio network controllers (RNCs) 36-40 and mobile switching centres (MSCs) 42-44. Each Node B 26-31 is principally designed to serve its primary cell, with each base station sub-system containing one or more transceivers. Each RNC 36-40 may control one or more Node Bs 26-31, with specific RNCs 36-40 either directly connected or interconnected through MSCs 42-44. The RNCs 36-40 are therefore able, if desired, to communicate with one another to pass system administration information therebetween, with RNCs responsible for establishing and maintaining control channel and traffic channels to serviceable subscriber units affiliated therewith. The interconnection of RNCs therefore allows the cellular communication system to support soft-handover (as illustrated in relation to mobile subscriber unit 17).

Each MSC 42-44 provides a gateway to the PSTN 34, with MSCs interconnected through an operations and management centre (OMC) that administers general control of the cellular system 10, as will be understood. The various systems elements, such as RNCs 36-38 and OMC 46, will include control logic 48-52, with the various system elements usually having an associated memory or database 54 (shown only in relation to RNC 38 for the sake of clarity). The database 54 typically stores historically compiled operational data as well as in-call data and system information, such as

neighbouring cell site lists (i.e. the BA list). Databases associated with the RNCs, in accordance with a requirement of the present invention, further include measured E_b/N_0 values acquired (over time and preferably on a continuous basis) for different services offered in specific geographic locations. As regards the specific geographic information, this can be based on actual position (such as attained through global positioning systems), inferred displacement from Node B on the basis of timing advance and/or angle of arrival data obtained from a directional antenna) or merely on a cell specific basis.

The cellular communication system 10 may support underlay of a microcellular environment (or the like), with a plurality of micro-cells operationally controllable by a RNC. The micro-cells may operate an identical air-interface to the macro-cell.

Generally, as will be understood, a subscriber unit (whether in-call or in idle mode) is in communication with its nearest Node B. Occasionally, a subscriber unit, such as mobile station 17, may enter soft-handover in which case multiple base station sub-system (BSSs) provide up-link servicing capabilities to the subscriber unit. In certain instances, deep fades prevent communication between a subscriber unit and its nearest neighbouring base stations. Consequently, a distant BSS may, by necessity, have to provide service to a remote subscriber unit.

The present invention proposes a mechanism that refines convergence time to a required E_b/N_0 position for a desired QoS within a particular service within a cell. As will be appreciated, the RNC (of FIG. 1) operates on FER (or the like) to set E_b/N_0 targets within the outer power control loop of CDMA-based environments.

At initial deployment, the present invention contemplates that an initial (arbitrarily selected) default setting (for the outer control loop) is applied when the Node B is first deployed. Thereafter, for each service (such as voice, video or data), the

RNC logs the converged E_b/N_0 value of the outer power control loop for at least some, if not all, calls (preferably on a refined geographic basis as opposed to merely a cell-wide basis). With averaging of the converged E_b/N_0 value over a number of call instances (either a specific number or on a running-average basis), such an averaged E_b/N_0 value is used during the initial set-up of a call, thereby providing a statistically better estimate for E_b/N_0 that is less likely to degrade an interference environment (for being too high) and less likely to provide an inferior QoS (for being too low).

A simple example can be used to illustrate the potential of the inventive technique of the present invention. Consider two identical Node B's; a first deployed adjacent to a motorway and a second deployed in a micro-cellular scenario in a pedestrian shopping area. Clearly, for each service, respective outer loop targets should be different (arising from relative subscriber unit speeds/velocities). Specifically, a speech user travelling along the motorway will (generally) require significantly more received power to achieve the same quality of service as a speech user in the pedestrian shopping area.

The preferred embodiment of the present invention is arranged to recognise the local physical environments of the subscriber units demanding service, which local physical environment can be inferred from one of, or a combination of: an averaged direction of arrival estimate (of up-link transmissions incident to a adaptive antenna); phase and space diversity; timing advance requirements; GPS location reports; signal strength reports from multiple sites; and measures of velocity (either reported or implied). By identifying at least an approximate physical location of the subscriber unit, the Node B (having regard to the type of service requested, e.g. voice, data or multimedia) accesses its associated database of converged and averaged E_b/N_0 values to acquire an E_b/N_0 value as a start point for outer loop power control within the call. The acquired E_b/N_0 value should therefore approximate to the required QoS for the requested service.

The user equipment and/or the infrastructure-based equipment (such as the BTS, Node B or OMC) record converged and averaged E_b/N_0 values in associated databases accessible at call-initiation. The UE may communicate (during up-link control transmissions and on a regular, if not continuous, basis) converged E_b/N_0 values to the infrastructure to produce a more complete picture of the environment, especially in the case when the UE's outer power control loop is controlled from the infrastructure. With time, a multi-dimensional database (100 of FIG. 2) can be established for different services 102-106 (such as voice, data and multimedia) across a variety of variable parameters (such as speed 108) having regard to location (x_n, y_n), whereby continuously improved averages of converged/up-dated E_b/N_0 values 110 are cross-referenced to such parameters. As regards location data, it is preferred that locations are packaged into finite geographic regions that share a common propagation environment to avoid unnecessary duplication of like converged values for close geographically-located and close propagation-located areas. However, whilst such packaging limits the size of the database and ensures that a meaningful averaging of data can occur relatively quickly, packaging is undertaken only to an extent that a desired level of granularity (and hence optimisation of performance) is maintained with use of the database.

Convergence to the required outer loop target, as will be understood, is desirable from a system perspective because of optimisation of system capacity and interference limitation. In the context of a high data rate user occupying a significant proportion of the total capacity of a carrier, a difference between the maximum and minimum outer loop targets for the same service (as a function of propagation environment) will typically be in the range of 3dB. A fixed outer loop target (as used in the prior art) would typically therefore assume a mean value somewhere between the two extremes, and so it will take multiple radio frames (i.e. multiple 10ms periods) to converge to either of the two extremes. In a favourable propagation environment, a fixed outer loop target ensures the transmission of excess power into the system for several radio frames until

convergence has occurred. Such excessive power transmissions will reduce capacity during this transient period, with this being particularly undesirable in networks supporting bursty packet data with a minimum packet length commensurate with the frame repeat periods of 10ms. Consequently, with deployment of a time-averaged service and location specific E_b/N_0 value for the outer power control loop, principally in call set-up procedures, the preferred embodiment of the present invention ensures convergence in a statistically more efficient time. As such, CDMA system performance is optimised by the present invention, with required QoS provided at lower power and with greater efficiency, thereby yielding improved system capacity through an effective reduction in interference during acquisition to convergence within the outer power control loop.

The underlying principle of the present invention can also be applied in user equipment (UE) per se, with the invention finding applicability in both up-link and down-link scenarios irrespective of whether outer loop power control is administered from the subscriber site or in response to network originating commands, such as those emanating from the RNC, Node B or OMC.

In relation to a UE implementation, the UE is arranged to store a database of its own mean outer loop target (for each service), preferably with respect to respective cells. However, with mobility generally associated with UEs, meaningful time-averaging of multiple converged values for each service may be difficult to acquire, with such time-averaged E_b/N_0 values adversely affected by any lack of accurate location information. Of course, it is contemplated that the UE can augment infrastructure-based control by feeding 'recommendations' (derived from previous stored convergence or inferred from an instantaneous interference environment) on its preferred and initial outer loop target as part of a call establishment routine. Such recommendations may take the form of a UE's perceived E_b/N_0 requirement for the down-link, with the infrastructure ultimately

making a determination of whether the recommendation is appropriate (having regard to the overall interference environment).

The operating methodology of the preferred embodiment of the present invention is also able to react to changes in environment, e.g. the building of a new road near to a Node B. In addition, as new bearer services are defined, deployment of the present invention avoids the need to run extensive simulations or make further field measurements to derive the default outer loop threshold. Drive testing of a UE is not required since the present invention will produce a time-averaged converged E_b/N_0 value that will generally improve with time.

The operating methodology underlying a preferred embodiment of the present invention is shown in FIG. 3.

The process begins with either a page (from the Node B) or a RACH (i.e. an up-link call establishment request on a random access control channel [RACCH]) to initiate 150 call establishment from an idle mode. Call set-up may subsequently follow conventional CDMA procedures, such as described in U.S. Patents 5,854,785 and 5,920,550. In relation to call set-up, a determination 152 is made as to the required type of service, although this can be set, in default, by the system subject to instantaneous loading/capacity. Generally, the type of service is selected by the UE responsible for originating the call request, with the service requirement generally communicated between the UE and Node B (and hence the infrastructure equipment). Based on the service requirement, there is usually a QoS requirement (for a specific baud rate/bandwidth, etc.) for the call; this is determined at step 154. A determination or estimate 156 is then made as to UE location, with the system (generally the RNC or UE) selecting 158 a time-averaged E_b/N_0 value from the compiled database (100 of FIG. 2). The call can then be commenced with the selected time-averaged E_b/N_0 value. Of course, at roll-out the E_b/N_0 value could actually be an arbitrarily selected default value set

by an operator, although with time this value will change according to the underlying operational concept of the present invention.

Once in-call, the inner and outer power control loops continue to operate in a conventional manner, i.e. the system operates to converge 160 the outer control loop to an optimised E_b/N_0 value for a desired QoS. On a periodic or continuous basis, the database is up-dated 162 with the converged E_b/N_0 value with respect to UE location, with the E_b/N_0 values within the database therefore time-averaged relative to location.

Clearly, with time, a determination is made as to whether the call is to be released 164, with an affirmative decision path 166 yielding termination of the process and a negative decision path 168 returning the procedure to outer power control loop optimisation (step 160).

It will be understood that the underlying inventive concept can be provided as a software code update to existing equipment, with such software provided on a physical medium (such as a CD ROM) or by way of an air-interface transfer (or the like). By way of illustration, a computer program product 208 is shown in FIG. 1 to illustrate a commercial realisation of code.

It will, of course, be appreciated that the above description has been given by way of example only and that modifications in detail may be made within the scope of the present invention. For example, the E_b/N_0 target could be set within a subscriber unit 18 based on subscriber unit position determined by a integrated GPS system 200 operationally responsive to a microcontroller 202 (or the like) within the subscriber unit. E_b/N_0 convergence data is therefore acquired with time and stored in a memory 204 of the subscriber unit 18 for future use during CDMA-type call set-up procedures.

Furthermore, whilst the preferred embodiment generates a database having time-averaged convergence E_b/N_0 values used within the outer power control loop of a CDMA-based system, the underlying concept of generating a time-averaged database does not need to be limited to optimisation of the initial outer loop target. For example, time-averaged data collected by the system (in general) can be used to optimise any parameter of a Node B that is adversely influenced by a change in propagation environment, e.g. the bandwidth of the channel estimation filter.

With respect to UMTS, since cell sizes are relatively small (typically having a cell radius of about six hundred metres in an urban environment) the database may have a granularity for location on a cell-by-cell basis.

Although the invention has been described with regard to a cellular communications system employing CDMA technology, the inventive concepts contained herein are equally applicable to persons skilled in the art in other communication systems employing alternative multiple access technologies.

Claims

1. A communication system supporting a call between a base station and user equipment, the communication system comprising:

means for updating at least one initial outer power control loop threshold, for use by the base station and at least one user equipment when initiating a communication, wherein the updating of the initial threshold is performed dependent upon at least one communication service type.

2. A communication system as claimed in claimed in claim 1, wherein the communications system is a CDMA-based communication system, and the threshold is an E_b/N_0 value, the communication system further comprising;

means for converging an estimated E_b/N_0 value to a call-specific E_b/N_0 value representative of a desired quality of service between the base station and the user equipment.

3. A communication system as claimed in claim 2, the communication system further comprising;

a database storing a multiplicity of time-averaged E_b/N_0 values obtained in relation to a plurality of geographic locations within the CDMA-based communication system and in relation to at least one service; and

means for selecting one of the multiplicity of time-averaged E_b/N_0 values, at call initiation between the base station and the user equipment, for use as the estimated E_b/N_0 value within the outer power control loop, said one of the multiplicity of time-averaged E_b/N_0 values selected from the database dependent upon at least an assessed geographic location of the user equipment.

4. The communication system according to claim 3, wherein said selected one of the multiplicity of time-averaged E_b/N_0 values is selected by the means for selecting further based on a desired service for the call.

5. The communication system according to claim 2, further comprising:

means for communicating converged call-specific E_b/N_0 values to the database for updating the database on at least a periodic basis.

6. The CDMA-based communication system according to any one of claim 2, wherein the database is associated with one of the base station and a radio network controller.

7. A method of setting up a call between a base station and user equipment of a communication system, the method comprising the step of updating at least one initial outer power control loop threshold, for use by the base station and at least one user equipment when initiating a communication, wherein the updating of the initial threshold is performed dependent upon at least one communication service type.

8. A method of setting-up a call between a base station and user equipment according to claim 7, wherein the communication system is a CDMA-based communication system, the method further comprising the step of converging the initial outer power control loop threshold from an estimated E_b/N_0 value to a call-specific E_b/N_0 value representative of a desired quality of service between the base station and the user equipment.

9. A method of setting up a call according to claim 8, the method further comprising the steps of storing, in a database, a multiplicity of time-averaged E_b/N_0 values obtained in relation to a plurality of geographic locations within the CDMA-based communication system and in relation to at least one service; and selecting one of the multiplicity of time-averaged E_b/N_0 values, at call initiation between the base station and the user equipment, for use as the estimated E_b/N_0 value within the outer power control loop, said one of the multiplicity of time-averaged E_b/N_0 values selected from the database dependent upon at least an assessed geographic location of the user equipment.

10. The method of setting-up a call according to claim 8, further comprising the step of selecting said one of the multiplicity of time-averaged E_b/N_0 values further based on a desired service for the call.

11. Base site equipment for a communication system supporting a call between a transceiver and user equipment, the base site equipment including means for updating at least one initial outer power control loop threshold, for use by the base station and at least one user equipment when initiating a communication wherein the updating of the initial threshold is performed dependent upon at least one communication service type.

12. Base site equipment for a communication system according to claim 11, wherein the communication system is a CDMA communication system, the base site equipment further comprising:

means for controlling an outer power control loop for converging an estimated E_b/N_0 value to a call-specific E_b/N_0 value representative of a desired quality of service between the transceiver and the user equipment.

13. Base site equipment according to claim 12, wherein the base site equipment is coupled, in use, to a database storing a multiplicity of time-averaged E_b/N_0 values obtained in relation to a plurality of geographic locations within the CDMA-based communication system and in relation to at least one service; and wherein the base site equipment further includes:

means for selecting one of the multiplicity of time-averaged E_b/N_0 values, at call initiation between the transceiver and the user equipment, for use as the estimated E_b/N_0 value within the outer power control loop, said one of the multiplicity of time-averaged E_b/N_0 values selected from the database dependent upon at least an assessed geographic location of the user equipment.

14. The base site equipment of claim 13, wherein said selected one of the multiplicity of time-averaged E_b/N_0 values is selected by the means for selecting further based on a desired service for the call.

15. The base site equipment of claim 13, wherein the base site equipment is a radio network controller.

16. A method of controlling, within base site equipment, set-up of a wideband call between a transceiver and user equipment of a CDMA communication system the method comprising the step of updating at least one initial power control loop threshold, for use by the base station and at least one user equipment when initiating a communication, wherein the updating of the initial threshold is performed dependent upon at least one communication service type.

17. A method of controlling, within base site equipment, set-up of a wideband call between a transceiver and user equipment of a CDMA-based communication system according to claim 16, wherein the CDMA call is subject to power control from an outer power control loop that converges an estimated E_b/N_0 value to a call-specific E_b/N_0 value representative of a desired quality of service between the transceiver and the user equipment.

18. The method of controlling according to claim 16, the method further comprising the steps of storing, in a database, a multiplicity of time-averaged E_b/N_0 values obtained in relation to a plurality of geographic locations within the CDMA-based communication system and in relation to at least one service; and

selecting one of the multiplicity of time-averaged E_b/N_0 values, at wideband call initiation between the transceiver and the user equipment, for use as the estimated E_b/N_0 value within the outer power control loop, said one of the multiplicity of time-averaged E_b/N_0 values selected from the database dependent upon at least an assessed geographic location of the user equipment.

19. The method of claim 18, further comprising:

selecting said one of the multiplicity of time-averaged E_b/N_0 values further based on a desired service for the call.

20. A computer program element comprising computer program code means arranged to cause a controller in a communication system to implement procedure to perform the method steps of claim 7.

21. The computer program element of claim 20, embodied on a computer readable medium.

22. A subscriber unit for a communication system, the subscriber unit comprising:

means for updating at least one initial outer power control loop threshold for use by the base station and at least one user equipment when initiating a communication, wherein the updating of the initial threshold is performed dependent upon at least one communication service type.

23. The subscriber unit for a communication system according to claim 22, the subscriber unit arranged, in use, to support a wideband call to a transceiver in a CDMA communication system, the subscriber unit comprising:

means for administering an outer power control loop that converges an estimated E_b/N_0 value to a call-specific E_b/N_0 value representative of a desired quality of service between the transceiver and the subscriber unit.

24. The subscriber unit according to claim 23, further comprising a database storing a multiplicity of time-averaged E_b/N_0 values obtained in relation to a plurality of geographic locations within the CDMA-based communication system and in relation to at least one service; and

means for selecting one of the multiplicity of time-averaged E_b/N_0 values, at wideband call initiation, for use as the estimated E_b/N_0 value within the outer power control loop, said one of the multiplicity of time-averaged E_b/N_0 values selected from the database dependent upon at least an assessed geographic location of the user equipment.

25. The subscriber unit according to claim 24, wherein said selected one of the multiplicity of time-averaged E_b/N_0 values is selected by the means for selecting further based on a desired service for the call.

26. The subscriber unit according to claim 24, further comprising:

means for communicating converged call-specific E_b/N_0 values to the database for updating the database on at least a periodic basis.

27. A communication system supporting a call between a base station and user equipment, the communication system comprising:

means for controlling an operational parameter adversely influenced by a change in propagation environment;

a database storing a multiplicity of time-averaged operational parameters obtained in relation to a plurality of geographic locations within the communication system ;

means for selecting one of the multiplicity of time-averaged operational parameters for use as an initial estimate of the operational parameter adversely influenced by a change in propagation environment, said one of the multiplicity of operational parameters selected from the database dependent upon at least an assessed geographic location of the user equipment; and

means for converging the initial estimate of the operational parameter to a call-specific operational parameter optimised for the call.

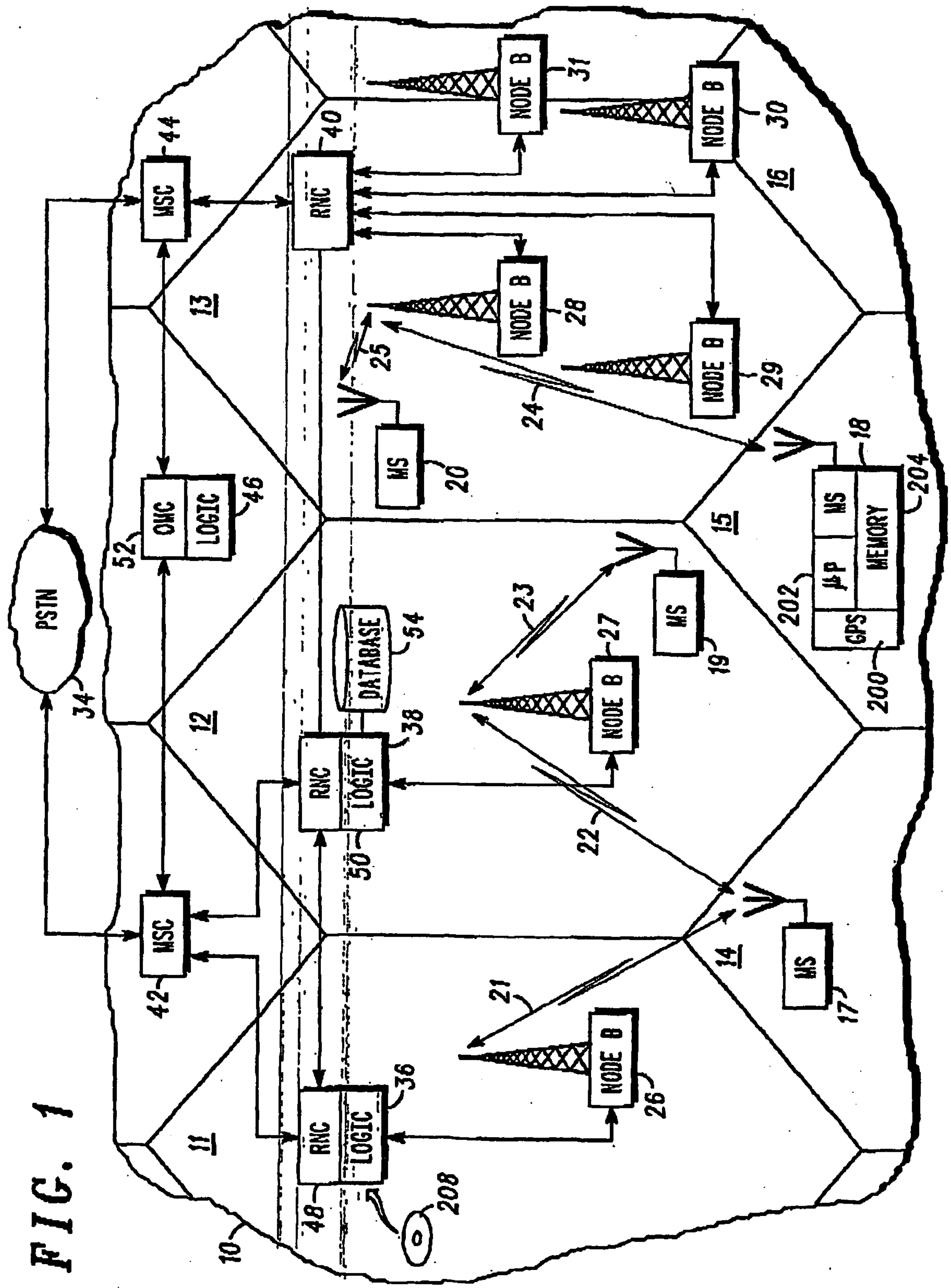

PSTN
34
MSC
42
MSC
44
OMC
LOGIC
52
46
RNC
LOGIC
36
48
RNC
LOGIC
38
50
RNC
40
DATABASE
54
NODE B
26
NODE B
27
NODE B
28
NODE B
29
NODE B
30
NODE B
31
MS
17
MS
19
MS
20
MS
18
GPS
μP
MEMORY
200
202
204
21
22
23
24
25
11
12
13
14
15
16
10
208

FIG. 1

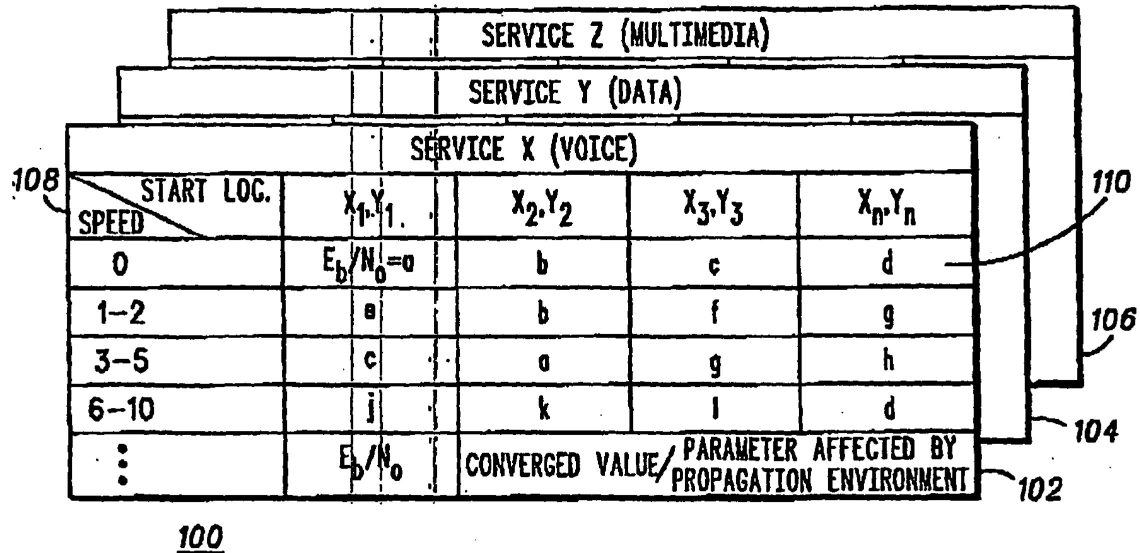

SERVICE Z (MULTIMEDIA)
SERVICE Y (DATA)
SERVICE X (VOICE)
108
START LOC.
SPEED
X_1,Y_1
X_2,Y_2
X_3,Y_3
X_n,Y_n
0
$E_b/N_0=a$
b
c
d
1–2
e
b
f
g
3–5
c
a
g
h
6–10
j
k
l
d
E_b/N_0
CONVERGED VALUE/ PARAMETER AFFECTED BY PROPAGATION ENVIRONMENT
110
106
104
102
100

FIG. 2

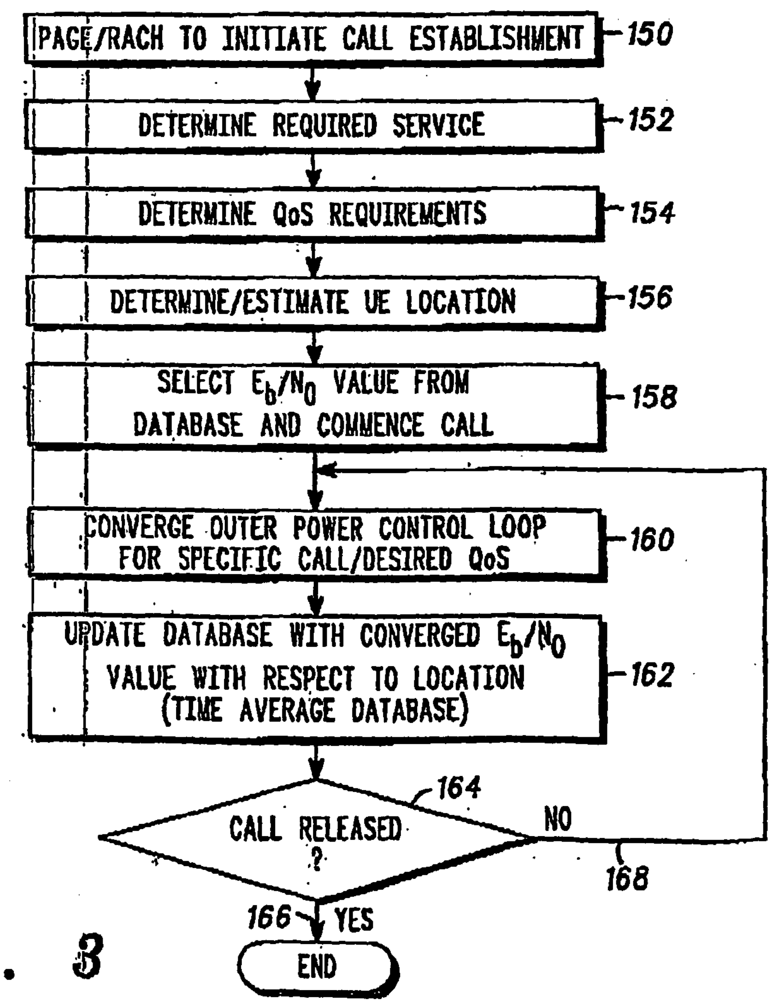

PAGE/RACH TO INITIATE CALL ESTABLISHMENT
150
DETERMINE REQUIRED SERVICE
152
DETERMINE QoS REQUIREMENTS
154
DETERMINE/ESTIMATE UE LOCATION
156
SELECT E_b/N_0 VALUE FROM DATABASE AND COMMENCE CALL
158
CONVERGE OUTER POWER CONTROL LOOP FOR SPECIFIC CALL/DESIRED QoS
160
UPDATE DATABASE WITH CONVERGED E_b/N_0 VALUE WITH RESPECT TO LOCATION (TIME AVERAGE DATABASE)
162
164
CALL RELEASED ?
NO
168
166
YES
END

FIG. 3

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP 01/06148

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04B7/005

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 709 973 A (NIPPON TELEGRAPH & TELEPHONE) 1 May 1996 (1996-05-01)	27
Y	column 9, line 24 - line 38; figures 4,5,7 column 10, line 42 - line 53 column 12, line 1 - line 12; figure 16 column 12, line 42 -column 13, line 12 column 13, line 21 - line 43 column 14, line 13 - line 47 column 15, line 3 - line 16 ---	1-26
Y	WO 98 58461 A (ERICSSON TELEFON AB L M) 23 December 1998 (1998-12-23)	1-26
A	abstract page 3, line 8 - line 25 page 4, line 23 -page 5, line 9 page 5, line 29 -page 6, line 3 ---	27
	-/--	

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
15 November 2001	22/11/2001

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Sieben, S

INTERNATIONAL SEARCH REPORT

Internati· ·pplication No
PCT/EP 01/06148

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6 151 508 A (KIM GUN-YEOB ET AL) 21 November 2000 (2000-11-21) & AU 48726 99 A (SAMSUNG ELECTRONICS CO LTD) 23 March 2000 (2000-03-23) column 2, line 47 -column 3, line 7 column 4, line 44 - line 64; figure 2 column 5, line 45 - line 61	1-27
A	EP 0 961 417 A (NIPPON ELECTRIC CO) 1 December 1999 (1999-12-01) column 3, line 2 - line 44; figures 1,2	1,2,7,8, 11,12, 16,17, 20-23,27

INTERNATIONAL SEARCH REPORT

Information on patent family members

Internati pplication No
PCT/EP 01/06148

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
EP 0709973	A	01-05-1996	CN	1123976 A ,B	05-06-1996
			CN	1264991 A	30-08-2000
			EP	1041732 A2	04-10-2000
			EP	1041733 A2	04-10-2000
			EP	0709973 A1	01-05-1996
			JP	3014308 B2	28-02-2000
			JP	8181653 A	12-07-1996
			US	5873028 A	16-02-1999
WO 9858461	A	23-12-1998	US	6173162 B1	09-01-2001
			AU	8050198 A	04-01-1999
			CN	1267410 T	20-09-2000
			EP	0990314 A1	05-04-2000
			WO	9858461 A1	23-12-1998
			TW	379486 B	11-01-2000
US 6151508	A	21-11-2000	AU	4872699 A	23-03-2000
			CN	1250342 A	12-04-2000
EP 0961417	A	01-12-1999	JP	3028802 B2	04-04-2000
			JP	11340948 A	10-12-1999
			CN	1245385 A	23-02-2000
			EP	0961417 A2	01-12-1999

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

CORRECTED VERSION

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
6 December 2001 (06.12.2001)

PCT

(10) International Publication Number
WO 01/93455 A1

(51) International Patent Classification[7]: H04B 7/005

(21) International Application Number: PCT/EP01/06148

(22) International Filing Date: 30 May 2001 (30.05.2001)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
0013056.7 31 May 2000 (31.05.2000) GB

(71) Applicant (*for all designated States except US*): MOTOROLA INC [US/US]; 1303 E. Algonquin Road, Schaumburg, IL 60196 (US).

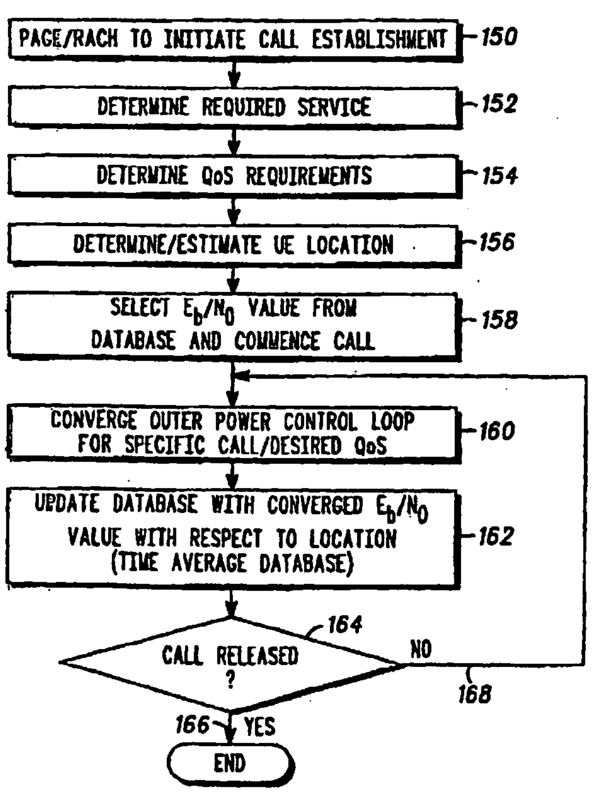
(72) Inventors; and
(75) Inventors/Applicants (*for US only*): O'NEIL, Rorie [GB/GB]; 25 Applewood Court, Swindon, Wiltshire SN5 7AH (GB). ANDERSON, Nicholas, William [GB/GB]; 26 Church Hill, Wroughton, Swindon, Wiltshire SN4 9JS (GB).

(74) Agent: JEPSEN, Rene; Motorola European Intellectual Property Operations, Midpoint, Alencon Link, Basingstoke, Hampshire RG21 7PL (GB).

(81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ,

[Continued on next page]

(54) Title: POWER CONTROL METHOD DURING CALL ESTABLISHMENT IN A RADIO COMMUNICATIONS SYSTEM



(57) Abstract: Upon call set-up requests in a CDMA-based communication system (1), an outer power control loop function is initially armed (158) with a time-averaged E_b/N_o value for a desired quality of service (QoS) of a specific service-type, e.g. voice, data or video, at a particular location. Clearly, different locations (X_n, Y_n) within the communication system (10) are subject to different propagation environments and so the time-averaged E_b/N_o values (110) vary between services and locations. Generally, as exemplified in Fig 3, an RNC (36-40) is operable to maintain a continuously updated database (100) through recodal of converged outer loop targets (for a cell or georgraphic location) for each specific type of service. When a new call is initiated (150), an initial outer power control loop target is taken (110) to be the time-averaged E_b/N_o valude from the database (100). In this way, any transient period (160) between call establishment (150-158) and convergence to a true required outer loop threshold is reduced, increasing overall network quality and capacity. The initial default within the database (100) doe not need to be chosed with particular care since it will soon be updated once an associated Node B (26-31) goes live, tereby avoiding the necessity of having to extensively system test new Node B sites in an interference-critical radio environment. The process of updating location-specific converged E_b/N_o values may be maintained (168) in-call.

WO 01/93455 A1

NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) **Designated States** *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report*

— *entirely in electronic form (except for this front page) and available upon request from the International Bureau*

(48) **Date of publication of this corrected version:**
2 May 2002

(15) **Information about Correction:**
see PCT Gazette No. 18/2002 of 2 May 2002, Section II

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.